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## NOTES ON THE BREEDING HABITS OF AMBLYSTOMA PUNCTATUM.

ALBERT HAZEN WRIGHT.

Probably in early spring no amphibian eggs are more common in central New York than those of *Amblystoma punctatum*. And yet our knowledge of the salamanders themselves, from their first appearance at this season through the egg-laying period, is meager as compared with what is known subsequent to the deposition of their eggs. Of the early part of the breeding period I wish to record some notes made at Ithaca by various members of the Department of Neurology and Vertebrate Zoölogy during the last eight years.

Ithaca is located at the south end of Cayuga Lake valley. North and south of the city are large swampy areas. On the east, south and west are high steep hills, through which are cut numerous ravines. In these places and in marshy areas on the hills, *Amblystoma* is found to be very abundant in early spring.

At this season the salamanders migrate from winter quarters to suitable breeding-places, and the Ithaca marshes have always proved a favorite locality. Along the borders and through the middle of these swamps are several steam railroads and one electric railway. These prove an excellent check on the first appearance of *Amblystomas*, toads, wood-, meadow- and pickerel-frogs, and were it not for these railroads our records of first appearance would coincide with those of egg-laying.

In one place, where the electric railway passes near the mouth of a large ravine, 100-150 of *Amblystoma punctatum* are killed yearly. On April 6, 1906, 54 were counted, all having been killed the previous evening. The migration does not begin until dark. The street cars run until 11 P. M. and cross this spot about thirty times in an evening. When, as above stated, 54 were killed in four hours, what must be the number that cross these tracks during these intervals and after 11 P. M. !

The migration is quite clear. In the ravines in early spring we obtain the adults, but never their eggs. At the time the

salamanders cross the railway tracks, or a day or two subsequently, we record spermatophores and eggs in the ditches and swamp just beyond the track. Many individuals are slightly injured, and these we often find under cover near by. They almost invariably have bruised heads.

In equal abundance this form may be taken along the other borders of this swamp. From another region living individuals are secured in considerable numbers. As many as fifteen have been taken here within one hour, nor is it unusual to secure as many over the same area, two or three days later. During the day the salamanders crawl under the logs and loose railroad ties which lie along either side of the railroad embankments. A rake usually is employed, for it is under the ties partially submerged in the water that we obtain the largest number of individuals. At the southwest corner of Cayuga Lake they are found to be common under the leaves at the foot of the high perpendicular rock walls.

Three of our amphibia appear almost simultaneously: the spotted salamander (*Amblystoma punctatum*), the peeper (*Hyla pickeringii*), and the woodfrog (*Rana sylvatica*). If there is any difference or succession it is indicated by the order in which they are named. During the last eight years these species have appeared in spring as follows:

<i>Amblystoma punctatum.</i>	<i>Hyla pickeringii.</i>	<i>Rana sylvatica.</i>
1900, April 6	April 19	April 14
1901, April 13	April 12	April 13
1902, March 25	March 28	April 4
1903, March 13	March 15	March 19
1904, April 1	April 3	April 5
1905, April 1	March 29	April 2
1906, March 28	April 6	April 6
1907, March 24	March 25	March 28

From the above it appears that *Amblystoma* in six of these eight years preceded the peeper and the woodfrog.

The first record for 1902 was based upon twenty specimens taken by Professor H. D. Reed, from under leaves along the base of the perpendicular rocks of the west shore of the lake. "They were all found in groups of two each and proved, with one or two exceptions, to be male and female."

Whether a preliminary courtship similar to that recorded for the spotted newt (*Diemyctylus viridescens*) obtains with *Amblystoma* has always been problematic. Clarke<sup>1</sup> says his captive "males showed no inclination to clasp the females, but quietly deposited quite large masses of an apparently rather thick liquid, opaque white, on the bottom of the dish in which they are kept." Smith<sup>2</sup> remarks that "in *Amblystoma* as in axolotl there is evidently no clasping of the female by the male such as occurs in *Triton* (*Diemyctylus*)."

Mr. A. A. Allen secured at Buffalo, N. Y., March 29, 1907, five individuals of *Amblystoma jeffersonianum*. Upon returning from his collecting trip he put them into a receptacle and immediately the smallest one (♂) embraced another (♀) exactly after the manner of the spotted newt. At Ithaca, April 2, after he had transferred them to a larger aquarium jar the same individual repeated the performance. The embrace was continued for some-time. Neither eggs nor spermatophores were subsequently laid, yet the fact is significant.

Of the intervals that exist between the first spermatophores deposited and the first eggs laid Professor Andrews<sup>3</sup> has noted that "24 hours or so" may intervene. Upon this point the following data may be of interest: in 1903, one interval of 2 days was recorded; in 1904, one of 4 days; in 1906, one of 6 days; in 1907, 4 days in one pond, 5 in another, and 7 in a third.

Egg-laying generally begins about the first of April. In two or three of the last eight years eggs have been noted before that date. In this period the earliest record is March 20, 1903. In 1901 they did not begin depositing eggs until after the middle of April. The egg-laying for the species may extend over a month or more. Rarely do we find fresh eggs after May 1. In 1907, our latest record for fresh eggs is April 30; our latest record for fresh spermatophores in the same pond, April 27.

<sup>1</sup> Clarke, S. F., "Development of *Amblystoma punctatum*, Studies from Biol. Lab. of Johns Hopkins Univ., No. II., 1880, p. 106.

<sup>2</sup> Smith, B. G., "The Breeding Habits of *Amblystoma punctatum* Linn.," *American Naturalist*, XLI., No. 486, June, 1907, p. 388.

<sup>3</sup> Andrews, E. A., "Breeding Habits of the Spotted Salamander (*Amblystoma punctatum*)," *American Naturalist*, Vol. 31, p. 636.

The first egg records for the last eight years follow:

1900, April	6						
1901, April	13						
1902, March	28,	3 days after first appearance of the species.					
1903, March	20,	7	"	"	"	"	"
1904, April	5,	4	"	"	"	"	"
1905, April,	11						
1906, April	14,	17	"	"	"	"	"
1907, March	30,	6	"	"	"	"	"

So far as I am able to determine there are very few observations upon egg-laying in nature. In 1878, Samuel F. Clarke made the following observations upon some captive females: "I was interested to find, after carefully watching the process a number of times, that the number of eggs deposited at a time depends upon accident. If the creature is disturbed, as by another individual striking against or touching it, or by the moving or jarring of the dish, she immediately suspends operations, and seeks some more quiet spot for the continuance of her labors. I have seen a single egg deposited and again a bunch containing one hundred and fifty. While the eggs are being extruded the animal usually lies with its anterior limbs extended laterally, while the hind limbs are curved around the opening of the cloaca and appear to assist in holding together the eggs as they are laid."

Egg-laying apparently takes place almost entirely at night. A chance discovery made while studying the early breeding habits of our local *Anura* may tend to confirm this view. At 9 P. M. of March 30, 1907, I found the *Amblystomas* of one pond swimming restlessly about its edges in considerable numbers and suspected that egg-laying was about to begin. At 9:30 P. M. another pond was visited and by means of an electric flashlight three different females of *Amblystoma punctatum* were found in the egg-laying position.

This pond is 30 × 15 feet in diameter, 2-3 feet deep, and the banks steep. The bottom is covered with dead leaves. In the pond are brush and growing smartweed (*Polygonum Hydropiper*). About the pond the first adult *Amblystomas* were taken March 24; the first spermatophores were deposited in the pond March 25; and the first eggs laid March 30.

All three females were laying at one time, and two of the three were simultaneously depositing upon two closely apposed stems of smartweed, the vent of the lower one being about an inch below that of the other. One female held on with both hind- and fore-limbs. Her head was appressed to the side of the stem. The second female was facing the first, her vent being slightly lower. She grasped the stem only by her hind limbs, was semi-erect and inclined diagonally to the side. The stems were so small and close together, that had the second desired it she could not have clasped the stem with her fore-limbs without embracing the first female. In both the tail extended diagonally downward, no prehensile tendencies being noted in any of the three.

The first female after about a minute disengaged herself and swam off. The second after a short time, did the same but was captured. Both bunches of eggs were at this moment no more than one half of an inch in diameter. In less than an hour they were two inches in diameter. The third female, only a foot away had not been disturbed by the sweeping of the net. She held on by her hind limbs only, leaving most of her body free. The bunch of eggs was only an inch from the top of the stem. This female was not perfectly erect but slightly arched.

When the second female was killed she emitted many eggs. Evidently, the first bunch, normal in number, was not all she had to lay. Nor is it unusual to record *Amblystoma* eggs laid in small bunches. In one of our temporary woodland pools, March 30, 1907, I found a stem of common nightshade (*Solanum Dulcamara*) which had within a length of one and a half feet 14 bunches of eggs, 15-20 eggs to a bunch. It is very doubtful if each bunch represents a different female, when it is well known that a female may have 150 or more eggs to deposit. It is more natural to conclude that these bunches represent the egg complement of one. The oviposition might have been interrupted, the female might have crept along the stem or after a period of emission she might have risen to the surface for air and then returned to the stem again as the swamp cricket frog (*Chorophilus triseriatus*) regularly does.

In captivity females when depositing may have quite long

intervals between the emissions of eggs. This spring a female taken at the height of the breeding season voided enough eggs to cover the bottom of a small aquarium jar. She was brought into the laboratory without an attendant male and after several hours began to deposit eggs. The deposition lasted ten days and the eggs first laid hatched. Captive females have more of a tendency to lay single eggs than in nature, yet single eggs have been recorded afield. Even before the female reaches the marshes or ponds she occasionally lays eggs. In several instances near the breeding grounds we have found under moist stones or logs one or two eggs laid by *Amblystomas*.

CORNELL UNIVERSITY,  
ITHACA, N. Y.